HP IO Accelerator version 3.1.1 VMware ESX and ESXi
User Guide

Abstract

This document describes software requirements for all relevant HP IO Accelerators using VMware ESX or ESXi operating systems. This document is intended for system administrators who plan to install and use HP IO Accelerators with a VMware ESX or ESXi operating system. It is helpful to have previous experience with HP IO Accelerators and a VMware ESX or ESXi operating system. This user guide is intended for IO Accelerator software release 3.1.1 or later.

Part Number: 682240-001
May 2012
Edition: 1

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About this guide

Contents summary

- Instructions on downloading and installing the approved driver and utilities
- Instructions on maintaining the IO Accelerator
- Description of the following IO Accelerator models:
  - HP IO Accelerator for BladeSystem c-Class
  - HP PCIe IO Accelerator
  - HP PCIe IO Accelerator Duo

△ **CAUTION:** Before upgrading to 3.x.x software and firmware, back up all data on the IO Accelerator. The 3.1.1 software and firmware reformat the drive which causes data to be lost if not backed up. The 3.1.1 software is not backward compatible with 1.2.x or 2.x software.

Introduction

Overview

Designed around ioMemory, a revolutionary storage architecture, HP IO Accelerator is an advanced NAND flash storage device. With performance comparable to DRAM and storage capacity on par with hard disks, the IO Accelerator increases performance so that every server can contain internal storage that exceeds the I/O performance of an enterprise SAN.

HP IO Accelerator is the first data accelerator designed specifically to improve the bandwidth for I/O-bound applications.

In addition to the hardware driver, the IO Accelerator also includes a VSL. This hybrid of the RAM virtualization subsystem and the disk I/O subsystem combines the best features of both systems. VSL functions as a disk to interface well with block-based applications and software, while also running like RAM underneath to maximize performance. This feature produces the following benefits:

- **Performance:** The VSL offers direct and parallel access to multiple CPU cores, enabling near linear performance scaling, consistent performance across different read/write workloads, and low latency with minimal interruptions and context switching.
- **Extensibility:** The VSL enables flash-optimized software development, making each IO Accelerator module a flexible building block for creating a flash-optimized data center.

Product naming

HP IO Accelerator Generation 1 devices include:

- AJ876A
- AJ877A
- AJ878A
- AJ878B
- BK836A

HP IO Accelerator Generation 2 devices include:

- QK761A
- QK762A
- QK763A

Performance attributes

IO Accelerator capacity Models AJ878B and BK836A	320GB	640GB
NAND type	MLC (Multi Level Cell)	MLC (Multi Level Cell)
Read Bandwidth (64kB)	735 MB/s	750 MB/s
Write Bandwidth (64kB)	510 MB/s	550 MB/s
Read IOPS (512 Byte)	100,000	93,000
Write IOPS (512 Byte)	141,000	145,000
Mixed IOPS* (75/25 r/w)	67,000	74,000
Access Latency (512 Byte)	30 µs	30 µs
Bus Interface	PCI-Express x4	PCI-Express Gen1 x4

IO Accelerator capacity Models QK762A and QK763A	785GB	1.2TB
NAND type	MLC (Multi Level Cell)	MLC (Multi Level Cell)
Read Bandwidth (1MB)	1.5 GB/s	1.5 GB/s
Write Bandwidth (1MB)	1.1 GB/s	1.3 GB/s
Read IOPS (Seq. 512 Byte)	443,000	443,000
Write IOPS (Seq. 512 Byte)	530,000	530,000
Read IOPS (Rand. 512 Byte)	141,000	143,000
Write IOPS (Rand. 512 Byte)	475,000	475,000
Read Access Latency	68µs	68µs
Write Access Latency	15µs	15µs
Bus Interface	PCI-Express Gen2 x4	PCI-Express Gen2 x4

*Performance achieved using multiprocessor enterprise server

- Enterprise data integrity
- Field upgradeability
- Green footprint, 7.5W nominal per device

NOTE: MSI was disabled to obtain these statistics.

Required operating environment

The HP IO Accelerator is supported for use in the following operating environments:

- VMware ESX 4.0
- VMware ESX 4.1
- VMware ESXi 4.1

CAUTION: Version 3.1.1 of the driver software is not backward-compatible. When you install version 3.1.1, you cannot revert to any previous version.

IMPORTANT: All operating systems must be 64-bit architecture.

NOTE: IO Accelerators cannot be used as hibernation devices.

The following scenarios are supported:

- Using the IO Accelerator as a VMFS datastore within the hypervisor, and then sharing that storage with guest operating systems. Guest operating systems can be 32-bit or 64-bit architecture because they are not directly using the IO Accelerator.
- Using PCI pass-through to enable a virtual machine to directly use the IO Accelerator. Only supported operating systems can use the device.

NOTE: PCI pass-through is currently supported on Windows® and Linux operating systems that are supported by HP. For installation instructions and a list of supported operating systems, see the *HP IO Accelerator Windows User Guide* or the *HP IO Accelerator Linux User Guide*.

NOTE: If you are passing the devices through the system, you do not have to install the IO Accelerator driver on an ESX or ESXi system. Install the driver on the guest system. Install the driver only if you plan to create a VMFS on the devices. For more information, see "Working with IO Accelerators and VMDirectPathIO (on page 42)."

NOTE: For best results, HP recommends running the latest Service Pack of a release.

Supported firmware revisions

VMware ESX version	IO Accelerator software	IO Accelerator firmware	Comments
VMware ESX 4.0	2.2.3 or 2.3.1	101583_6 or 101971_6 (2.3.1)	Update 1; 101583 is compatible with both software versions.
VMware ESXi 4.0	Not supported	Not supported	ESXi 4.0 is not supported.
VMware ESX 4.1	2.2.3 or 2.3.1	101583_6 or 101971_6 (2.3.1)	Version 101583 is compatible with both software versions
VMware ESXi 4.1	2.3.1	101583_6 or 101971_6 (2.3.1)	HP recommends 101971_6 firmware

NOTE: HP StorageWorks IO Accelerators require firmware version 101971_6 or 101583. HP PCIe IO Accelerators also support firmware version 101971_4.

Supported hardware

HP IO Accelerator for BladeSystem c-Class

BladeSystem c-Class IO Accelerators have two distinct designs for the respective server product lines. The G1 through G7 IO Accelerator adapter is provided in a c-Class Type 1 Mezzanine card form factor. It can be installed in both Type 1 and Type 2 mezzanine slots within the c-Class blade G1 through G7 servers, enabling a total of two cards in a half-height server blade, and three cards in a full-height server blade and up to 6 in a double-high, double-wide server (BL680c).

The Gen8 adapter is provided in a c-Class Type B Mezzanine card form factor. It can only be installed in Type B mezzanine slots within the Gen 8 or later servers, enabling one IO Accelerator in a half-height Gen8 server.

The Type I mezz card and the Type B mezz card are distinguished by the mezzanine connector. The type B card is slightly larger than a Type I mezz card.

The amount of free RAM required by the driver depends on the size of the blocks used when writing to the drive. The smaller the blocks, the more RAM is required. The table below lists the guidelines for each 80GB of storage. For the latest information, see the *QuickSpecs* sheet to the *HP IO Accelerator for HP BladeSystem c-Class* at HP Customer Support (http://www.hp.com/support).

The Remote Power Cut Module for the c-Class blade mezzanine card provides a higher level of protection in the event of a catastrophic power loss (for example, a user accidentally pulls the wrong server blade out of the slot). The Remote Power Cut Module ensures in-flight writes are completed to NAND flash in these catastrophic scenarios. Without the Remote Power Cut Module, write performance is slower. Writes are not acknowledged until the data is written to the NAND module, thereby slowing performance. When the Remote Power Cut Module is installed, writes are acknowledged by the IO Accelerator controller to the driver. The IO Accelerator controller then completes the write to the NAND module.

The IO Accelerators (QK761A, QK762A, and QK763A) for Gen 8 BladeSystem c-Class have the power cut functionality embedded on the card. They offer the protection without requiring the remote power cut module.

> **NOTE:** The Remote Power Cut Module is used only in the AJ878B and BK836A models. Without the Remote Power Cut Module, write performance is slower.

HP PCIe IO Accelerator minimum requirements

- An open PCI-Express slot—The accelerator requires a minimum of one half-length, half-height slot with a x4 physical connector. All four lanes must be connected for full performance. HP PCIe IO Accelerator Duo requires a minimum of a full-height, half-length slot with an x8 physical connection. If your system is using PCI 1.1, all x8 signaling lanes must be connected for full performance. If your system is using PCI 2.0, for full performance you only have to connect x4 signaling lanes.

  > **NOTE:** For PCIe IO Accelerators, using PCIe slots greater than x4 does not improve performance.

  > **NOTE:** The power cut feature is built into PCIe IO Accelerators; therefore, no Remote Power Cut Module is necessary.

- 300 LFM of airflow at no greater than 50°C. To protect against thermal damage, the IO Accelerator also monitors the junction temperature of its controller. The temperature represents the internal temperature of the controller, and it is reported in `fio-status` report. The IO Accelerator begins throttling write performance when the junction temperature reaches 78°C. If the junction temperature continues to rise, the IO Accelerator shuts down when the temperature reaches 85°C.

  > **NOTE:** If you experience write performance throttling due to high temperatures, see your computer documentation for details on increasing airflow, including fan speeds.

- Sufficient RAM to operate—The amount of RAM that the driver requires to manage the NAND flash varies according to the block size you select when formatting the device (filesystem format, not low-level format). For a virtual machine using an IO Accelerator directly (using PCI pass-through), consult the user guide for the installed operating system. The following table lists the amount of RAM required per 100GB of storage space, using various block sizes. The amount of RAM used in driver version 3.0 is significantly less than the amount used in version 1.2.x.

Average block size (bytes)	RAM usage for each 80 GB IO Accelerator (Megabytes)	RAM usage for each 100 GB IO Accelerator (Megabytes)	Minimum system RAM requirement for 320 GB MezzIO Accelerator*
8,192	250	280	1 GB
4,096	400	530	1.6 GB
2,048	750	1,030	3 GB
1,024	1,450	2,000	5.8 GB
512	2,850	3,970	11.4 GB

Average block size (bytes)	Minimum system RAM requirement for 640 GB MezzIO Accelerator*	Minimum system RAM requirement for 785 GB MezzIO Accelerator*	Minimum system RAM requirement for 1.2 TB MezzIO Accelerator*
8,192	2 GB	2.2 GB	3.4 GB
4,096	3.2 GB	4.2 GB	6.4 GB
2,048	6 GB	8.1 GB	12.4 GB
1,024	11.6 GB	15.7 GB	24 GB
512	22.8 GB	31.2 GB	47.6 GB

* For IO Accelerator use only. Additional RAM is needed for system operating system and applications.

HP PCIe IO Accelerator Duo requirements

In addition to the IO Accelerator cooling and RAM requirements listed in the previous table, the IO Accelerator Duo requires at least:

- A PCIe Gen1 x8 slot or a PCIe Gen2 x4 slot
- A minimum of a full-height, half-length slot with a x8 physical connection. For systems with PCI 1.1, all eight signaling lanes must be active for full IO Accelerator Duo performance. For systems with PCIe 2.0, only four signaling lanes must be active for full performance.

NOTE: With driver version 3.1.0 and later, the driver detects in the BIOS if the PCIe slot supports a 75W power draw. If the slot supports up to 75W, the IO Accelerator device draws up to that amount of power. However, if an external power cable is used, power is only supplied by that cable.
To verify whether a slot is supplying 75W, view the system logs or use the `fio-pci-check` utility.

Before you begin

Before installing the IO Accelerator driver, be sure you have properly installed the IO Accelerator devices. For more information, see the hardware installation instructions that came with your IO Accelerator.

After you install this version of the IO Accelerator driver, you might have to upgrade the firmware to enable operation. For more information, see "Upgrading firmware ("Upgrading the firmware using ESX" on page 16)."

IO Accelerators cannot be installed as part of an ESX or ESXi installation.

Software installation

VMDirectPathIO

The VSL software is only required for ESX or ESXi if you plan to use the IO Accelerator device as a VMFS datastore. If you are passing the devices through using VMDirectPathIO, you do not need to install the VSL on your the ESX or ESXi system. Instead, install the VSL on the guest system. For example, pass the device through to a Windows VM, and then install the Windows VSL on that VM. For installation and user instructions, see the *HP IO Accelerator for Windows User Guide*.

When passing through an IO Accelerator device, you must be aware of certain constraints. For more information, see "Working with IO Accelerators and VMDirectPathIO (on page 42)."

Command-line installation

To install and manage the VSL driver, you must use a CLI.

ESX command-line installation

ESX includes the COS. The CLI is available on the host or through an SSH connection.

ESXi command line installation

HP recommends installing VMware vCLI for your ESXi system. Install a vCLI package on a physical machine running on a Linux or Windows operating system. For more information on VMware vCLI, see the VMware website (http://www.vmware.com/support/developer/vcli/). HP does not recommend using the vCLI on a virtual machine that is hosted on your ESXi system. The IO Accelerator installation and configuration processes involve putting the ESXi host into maintenance mode and rebooting the host.

When installing the VSL, you can choose to use the TSM, also known as Shell or SSH (when used remotely), instead of the vCLI. The TSM might be required for managing or troubleshooting your device with the command-line utilities.

△ **CAUTION:** To avoid damage to the system, VMware recommends using TSM only for the purposes of troubleshooting and remediation. VMware recommends using the vCLI or any other VMware Administration Automation Product to perform routine ESXi host configuration tasks that do not involve troubleshooting. For more information on using TSM, see the VMware Knowledge Base article (http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1017910).

Installation overview

Before installing the IO Accelerator driver, make sure you have properly installed the IO Accelerator devices. For more information, see the *HP IO Accelerator Hardware Installation Guide.*

1. If necessary, uninstall previous versions of the VSL and utilities. For instructions, see "Common maintenance tasks (on page 25)."
2. Install the latest version of the VSL and command-line utilities.
3. To load the driver and attach the IO Accelerator devices, reboot the ESX or ESXi system.
4. If necessary, upgrade the firmware to the latest version.
5. Configure the device to support VM disks.

△ **CAUTION:** The IO Accelerator device is designed to be used as a data storage disk or caching device. HP does not support the installation of an ESX or ESXi operating system and booting from the IO Accelerator device.
HP does not recommend labeling an IO Accelerator device as a **VMware Block Device** and installing the ESX or ESXi operating system on an IO Accelerator device. If you do so, the installation will fail when the system is rebooted.

Downloading the VMware ESXi driver

Download the installation packages to a remote machine running the vCLI.

The driver is available as an offline bundle from the HP website (http://www.hp.com/go/support). Navigate to the appropriate folder for your operating system. Example file names:

- `iomemory-vsl_<version>.offline-bundle.zip`
- `cross_vmware-esx-drivers-block-iomemory-vsl_<version>-offline-bundle.zip`

The offline bundle might be in a .zip file archive:

`iomemory-vsl-<version>.zip`

NOTE: If the .iso image is available, it contains the same offline bundle that is available as a standalone download. In most cases, .iso images are used to create CDs so the software can be installed as part of an ESX installation. However, the VSL cannot be installed as part of an ESX installation. Download the offline bundle unless you want to transfer the files to the ESX host using a CD.

Download the following support files as appropriate for your version.

Package	Installation instructions
`iodrive_<version>.fff`	Upgrading the firmware
`fio-remote-util-<version>.noarch.rpm`	Installing Python WBEM packages (optional)

The `fio-remote-util-<version>.noarch.rpm` or `.deb` package is available in the Linux download folders. Download this package from the folder for your Linux distribution (for the remote machine). For example, if you install these remote utilities on a Linux system running RHEL 5, go to that download folder to find this package.

Transferring the VSL files to the ESX or ESXi server

You must transfer the firmware file to the ESX or ESXi host. Depending on your ESX or ESXi version and your preferred installation method, you might also have to transfer the two bundle installation files to the host. HP recommends transferring all the files at this point and then choosing the installation method later.

With any method that you select for transferring the files, HP recommends saving the files to a datastore on the host. The example paths to the bundles and firmware in this guide show them located in a bundles directory on a datastore:

`/vmfs/volumes/<datastore>/bundles/`

Where `datastore` is the name of the datastore where the files are saved.

Transfer methods

You can transfer the files using one of several methods, including:

- vSphere Client
- vCLI vifs command
- SCP (using SSH)

You can copy the files to the host from your remote system or from an NFS share.

vCLI example

To transfer files to the ESX or ESXi host using vCLI:

1. On your remote machine, be sure you have downloaded the appropriate files, and record the file locations.
2. Choose an available datastore with at least 200MB of available storage on the hypervisor that you will use to temporarily store the bundles.
3. Create a directory in the datastore named `bundles` using the `vifs` remote command:

   ```
   vifs --server <servername> --mkdir "[<datastore>]bundles"
   ```

   The brackets ([]) and quotes ("") are required. Substitute your datastore name for the <datastore> variable.

   IMPORTANT: When using the vCLI on a Windows operating system, many of the commands are slightly different. Most of the commands end with `.pl`. Throughout this guide, when you run the vCLI on a Windows operating system, you must add `.pl` to the command. For a Windows operating systems, this command is:

   ```
   vifs.pl --server <servername> --mkdir "[<datastore>]bundles"
   ```

4. Use the following example command line to transfer each file individually to the bundles directory of the datastore:

   ```
   vifs --server <servername> --put "<path-on-local-machine>/<filename>"
   "[<datastore>]bundles/<filename>"
   ```

   Where <filename> is the full filename, For example:

   - `iodrive_<version>.fff`
   - `cross_vmware-esx-drivers-block-iomemory-vsl_<version>.offline-bundle.zip`
   - `iomemory-vsl_<version>.offline-bundle.zip.`

Installing the VSL on ESXi 5.0

These instructions describe how to install the VSL on a single hypervisor. However, if you are familiar with the VUM plugin for the Virtual Center Server (vCenter Server), you can use that method to install the VSL on multiple hosts. For more details on VUM, see the vCenter Server documentation.

IMPORTANT: HP does not recommend performing an upgrade installation. Instead, uninstall the previous version of the VSL software before you install this version. For more information on uninstalling the software, see "Common maintenance tasks (on page 25)."

Before you install the VSL, stop all Virtual Machines and put the ESX or ESXi host into maintenance mode using the vSphere client or the vCL.

You can choose to install the software using the vCLI or SSH. Whether you use the SSH or vCLI, you must first transfer the files to a datastore on the ESX or ESXi host.

Installing the VSL on ESXi 5.0 using vCLI

1. To install the bundle, run the following command against your ESXi 5.0 system using the vCLI:

   ```
   esxcli --server <servername> software vib install -d <offline-bundle>
   ```

   Where `<offline-bundle>` is the absolute path to the offline bundle on the hypervisor host. For example, if the offline bundle is in the `bundles` directory of a datastore with the name of `datastore1`, the local path is: `/vmfs/volumes/datastore1/bundles/<offline-bundle>`.

   This absolute path must begin with a forward slash (/) or ESXi will return an error message.
2. Reboot your ESXi system.

Installing the VSL on ESXi 5.0 using the command-line

1. Navigate to the directory where you have transferred the offline bundle.
2. To install the bundle, run the following command against your ESXi 5.0 system:

   ```
   esxcli software vib install -d <offline-bundle>
   ```

   Where `<offline-bundle>` is the full name of the offline bundle that you downloaded.

   The VSL and command-line utilities are installed on the host.
3. Reboot your ESXi system.
4. Continue to "Upgrading firmware ("Upgrading the firmware using ESX" on page 16)."

Installing the VSL on ESX or ESXi 4.x

IMPORTANT: HP does not recommend performing an upgrade installation. Instead, uninstall the previous version of the VSL software before you install this version. For more information on uninstalling the software, see "Common maintenance tasks (on page 25)."

Before you install the VSL, stop all Virtual Machines and put the ESX or ESXi host into maintenance mode using the vSphere client or the vCL.

You can choose to install the software using the vCLI or SSH.

Installing the VSL on ESX or ESXi 4.x using vCLI

IMPORTANT: Do not save the installation bundles to the ESX or ESXi 4.x host when using the vCLI. Store them on the remote system.

1. On your remote system, navigate to the directory that contains the downloaded files.
2. To install the bundle, run the following command against your ESXi or ESXi 4.x system using the vCLI:

   ```
   vihostupdate --server <server-name> --install --bundle
   ./*offline-bundle.zip
   ```

   The VSL and command-line utilities are installed on the host.
3. Reboot your ESX or ESXi system.

Installing the VSL on ESX or ESXi 4.x using the command-line

You can use the COS on ESX 4.x or the TSM or SSH on ESXi 4.x to install the software. In both cases, you must first transfer the files to the host.

1. Navigate to the directory where you have transferred the offline bundle.
2. To install the VSL using the offline bundle, run the `esxupdate` command:

   ```
   $ esxupdate --bundle=<offline-bundle.zip>
   ```

   Where `<offline-bundle>` is the full name of the offline bundle that you downloaded.

   The VSL and command-line utilities are installed on the host.
3. Reboot the host system.
4. Continue to "Upgrading firmware ("Upgrading the firmware using ESX" on page 16)."

Upgrading the firmware using ESX

After the IO Accelerator driver is loaded, ensure that the firmware is updated. To verify the update, run the `fio-status` command-line utility from a supported environment.

If the output shows that the device is running in minimal mode, use the `fio-update-iodrive` utility in TSM or the `fio-update-iodrive.py` remote script to upgrade the firmware.

If you previously installed VSL 2.x or earlier on your IO Accelerator device, you must upgrade the firmware by following the instructions in "Upgrading device firmware from VSL 1.x.x or 2.x.x to 3.x.x (on page 17)." When installing a new IO Accelerator device along with existing devices, it is best to upgrade all of the devices to the latest available versions of the firmware and VSL. The latest versions are available on the HP website (http://www.hp.com/go/support).

When using VMDirectPathIO, if you upgrade the firmware on an IO Accelerator device, you must cycle the power for the change take place. Restarting the virtual machine won't apply the change.

CAUTION: Do not attempt to downgrade the firmware on any IO Accelerator device. Doing so might void your warranty.

IMPORTANT: Your IO Accelerator device might have a minimum firmware label affixed (for example, "MIN FW: XXXXXX"). This label indicates the minimum version of the firmware that is compatible with your device.

NOTE: When using PCI pass-through, if you upgrade the firmware on an IO Accelerator, you must cycle the power for the change to take place. Restarting the virtual machine does not apply the change.

Upgrading device firmware from VSL 1.x.x or 2.x.x to 3.x.x

△ **CAUTION:** You cannot downgrade an HP IO Accelerator device firmware to an earlier version after you have upgraded the device.

△ **CAUTION:** Upgrading IO Accelerator devices that were previously configured for VSL 1.x.x or 2.x.x to work with VSL 3.x.x requires a low-level media format of the device. No user data is maintained during the media format process. Be sure to backup all data on your IO Accelerator device as instructed before upgrading the firmware.

Version 3.1.x of the HP IO Accelerator VSL supports new features, including the latest generation of IO Accelerator architecture and improved Flashback protection. These features require the latest version of the firmware. Every IO Accelerator device in a system running 3.1.x or later must be upgraded to the latest version of the firmware.

For example, if you have a system running 2.3.1 HP IO Accelerator VSL with IO Accelerator devices previously installed, and you want to install new IO Accelerator Gen2 devices (that require the latest version of the firmware), then you will need to upgrade all of the existing devices to the latest firmware version.

Upgrade path

Depending on the current version of your HP IO Accelerator device, to preserve the internal structure of the device, you might have to perform multiple upgrades. The following path is the minimum upgrade path that you must follow. Upgrade the HP IO Accelerator VSL software on the system, and upgrade the firmware to the compatible version in the following order:

1.2.4 > 1.2.7 > 2.1.0 > 2.2.3 > 3.1.x

For VSL upgrade information for the HP IO Accelerator, see the *HP IO Accelerator Release Notes* on the HP website (http://www8.hp.com/us/en/support-drivers.html). General upgrade instructions, including the firmware update instructions, are available in the *HP IO Accelerator User Guide* for each operating system.

Overformatting not supported

The `-o overformat` option is not supported in the 3.x.x VSL software. All upgraded HP IO Accelerator devices are formatted to the maximum advertised capacity, regardless of whether the device was overformatted prior to the upgrade.

Upgrading procedure

Be sure to follow the upgrade path and make sure that all previously installed IO Accelerator devices are updated with the appropriate 2.3.1-compatible firmware.

If you plan to use IO Accelerator Gen1 devices and IO Accelerator Gen2 devices in the same host, perform this upgrade on all existing IO Accelerator Gen1 devices before installing the new IO Accelerator Gen2 devices.

1. Prepare each existing IO Accelerator device for upgrade:
   a. Backup user data on each IO Accelerator device.

CAUTION: Upgrading IO Accelerator devices that were previously configured for VSL 1.x.x or 2.x.x to work with VSL 3.x.x requires a low-level media format of the device. No user data is maintained during the media format process. Be sure to backup all data on your IO Accelerator device as instructed before upgrading the firmware.

Do not back up the data onto another IO Accelerator device on the same system. The backup must be to a local disk or to an externally attached volume.

b. Run the `fio-bugreport` command-line utility and save the output. This output captures the device information for each device in the system. This device information will be useful in troubleshooting any upgrade issues. For example:

```
fio-bugreport
```

2. To uninstall the 2.3.1 HP IO Accelerator VSL software, stop all of the virtual machines and put the host in maintenance mode. Then follow the instructions for your platform:

a. To uninstall the VSL from ESXi 5.0 using vCLI, run the following command:

```
esxcli --server <servername> software vib remove -n block-iomemory-vsl
```

b. To uninstall the VSL from ESXi 4.x using vCLI:

i. To determine the bundle "bulletin" ID, run the following command:

```
vihostupdate --server <server-name> --query
```

Sample output:

--------Bulletin ID-------- -----Installed----

-------------Summary--------------

iomemory-vsl-2.2.0.7601742 2011-02-08T10:37:05

```
iomemory-vsl: block driver for ESXi 4.1.X
```

ii. To remove the "bulletin" containing the driver and utilities, run the following command:

```
vihostupdate --server <server-name> --remove --bulletin <Bulletin-ID>
```

c. To uninstall the VSL from ESX 4.x:

i. Enter the following command to determine the Bulletin ID of any previously installed versions:

```
esxupdate query
```

Sample output:

------Bulletin ID------ -----Installed----

-----------------Summary-----------------

iomemory-vsl-3.0.6.360 2012-01-16T03:49:33

```
iomemory-vsl: block driver for ESX/ESXi 4.X
```

ii. To remove installed versions, run the following command:

```
esxupdate -b <Bulletin-ID> remove
```

3. Install the new VSL and related packages:

a. Download the VSL offline bundle and firmware from the HP website (http://www.hp.com/go/support). For more information, see "Downloading the driver ("Downloading the VMware ESXi driver" on page 13)."

b. Install the VSL and utilities. Follow the instructions in "Installing the VSL on ESX or ESXi 4.x (on page 15)" or "Installing the VSL on ESXi 5.0 (on page 15)," and then return to this procedure. Be sure to follow the suggestion to copy over the firmware file to the ESX or ESXi host, and make note of the firmware location.

c. Reboot the system.

4. Update the firmware on each device to the latest version using the `fio-update-iodrive` TSM or COS command-line utility.

   CAUTION: Do not turn off the power during a firmware upgrade, because this might cause device failure. If a UPS is not in place, consider adding one to the system before performing a firmware upgrade.

   Sample syntax:

   ```
   fio-update-iodrive <iodrive_version.fff>
   ```

   Where `<iodrive_version.fff>` is the path to the firmware archive. This command updates all of the devices to the selected firmware. If you wish to update specific devices, consult the utility reference for more options.

5. Reboot the system.

   If the `fio-status` command is run, a warning that the upgraded devices are missing a lebmap appears. This warning is customary, and the issue will be corrected in the next step.

   CAUTION: Running the `fio-format` command in the next step erases the entire device, including user data. After this format is started, the device cannot be downgraded to the 2.x driver without voiding your warranty.

6. Format each device using the `fio-format` command. For example:

   ```
   fio-format <device>
   ```

   You are prompted to confirm you want to erase all data on the device. The format might take an extended period of time, depending on the amount of wear on the device.

7. Using the following command, attach all IO Accelerator devices:

   ```
   fio-attach /dev/fct*
   ```

8. Using the following command, check the status of all devices:

   ```
   fio-status -a
   ```

Your IO Accelerator devices are now successfully upgraded for this version of the HP IO Accelerator. You can now install any IO Accelerator Gen2 devices.

Enabling PCIe power

For PCIe IO Accelerators, if you have installed any dual IO Accelerator devices, such as the HP ioDrive2 Duo, then the device might require additional power than the minimum 25 W provided by PCIe Gen2 slots to properly function.

For instructions on enabling the device to draw additional power from the PCIe slots, see "Enabling PCIe power override (on page 23)."

Configuring the device to support VM disks

△ **CAUTION:** ESX and ESXi require 512B sector sizes. New IO Accelerator devices come pre-formatted with 512B sector sizes from the factory. If yours is a new device, there is no need to format it.
However, if your IO Accelerator device was previously used in a system that allowed for larger sector sizes (such as Linux and 4KB sectors), then you must perform a format using the `fio-format` utility. To prevent data loss, follow formatting instructions carefully, including disabling and re-enabling auto attach.

Within the vSphere Client, select the Configuration tab. Under Hardware click Storage, then click Add Storage in the top right corner. The Add Storage wizard appears. Use this wizard to configure the device.

For more information, and an explanation of options, including setting the VM file system block size, consult your vSphere documentation.

The preferred type of virtual disk is `eagerzeroedthick`. HP does not recommend thin provisioning because it degrades performance significantly.

You can now store VMs on IO Accelerator devices.

Modifying a VMware resource pool to reserve memory

Under certain circumstances, the ESX or ESXi operating system might temporarily require all or most of the RAM available on the system, leaving no memory for the VSL. For example, a host running VMware View might need to rapidly provision multiple VDI images. This requirement might happen so quickly that the host memory is temporarily exhausted.

If the VMs starve the VSL of RAM, the IO Accelerator devices might go offline or stop processing requests. To address this issue, follow the procedure and guidelines for limiting memory consumed by the VMs.

HP recommends limiting RAM available to the VMs equal to Total Host RAM - RAM equivalent to 0.5% of the total IO Accelerator device capacity. For more information on this calculation, see the following example scenario. The easiest way to set this limit is by modifying the user pool.

The exact amount to limit is workload dependent and requires tuning for specific use cases.

To modify the user pool, perform the following steps using the vSphere client:

1. Click the **Summary** tab in the vSphere client to view the current memory usage and capacity.
   The total IO Accelerator device datastore capacity is also visible. Record the capacity.
2. Navigate to the user Resource Allocation window:
   a. Select the host **> Configuration** tab **> Software** pane **> System Resource Allocation** link **> Advanced** link. The **System Resource Pools** appear.
   b. Select the user node under the host tree. The details for the user appear.
   c. Click the **Edit settings** link. The user **Resource Allocation** window appears.
3. Limit the memory allocated to the VMs:
   a. Under **Memory Resources**, clear the **Unlimited** checkbox so you can set the limit for memory resource allocation.
   b. Set the limit on VM memory consumption.

Example scenario:

An ESXi host has the following:

- Memory capacity of 36,852 MB
- Total IO Accelerator device datastore capacity of 320 GB (or approximately 320,000 MB).

  320,000 MB device capacity * 0.5% of device capacity approximately 1600 MB of RAM equivalent.

  36,852 MB total memory capacity - 1600 MB free = 35,252 MB of memory limited to the host.

The new value under **Limit** in **Memory Resources** is 35,252 MB.

Using the IO Accelerator as swap with ESX

The IO Accelerator cannot be used as a swap device for the ESX or ESXi host.

However, the IO Accelerator can be used as swap for virtual machines. To use the IO Accelerator as swap for a virtual machine:

1. Go to **VMware vSphere Client > Configuration > Virtual Machine Swapfile Location.**
2. Indicate the appropriate Datastore location as the virtual machine swapfile location.

Maintenance

Maintenance tools

The IO Accelerator includes both software utilities to maintain the device and external LED indicators to display the status. You can also install SNMP as a monitoring option.

The following are the most common tasks for maintaining your IO Accelerator. You can also use the IO Accelerator Management Tool application to perform firmware upgrades. For more information, see the *HP IO Accelerator Management Tool User Guide*.

Management utilities for ESXi

Use COS/Shell/TSM command-line utilities to manage the VSL. These utilities are installed with the VSL software. To use these utilities on ESXi, the Shell/TSM must be enabled.

For more information about these utilities, see "Command-line utilities for TSM or COS ("Command-line utilities for Tech Support Mode" on page 22)."

Command-line utilities for Tech Support Mode

Several command-line utilities are included in the installation packages. These command-line utilities are only accessible through the VMware TSM, also known as SSH, in ESXi or COS in ESX.

IMPORTANT: VMware suggests that TSM only be used for the purposes of troubleshooting and remediation. VMware recommends using the vSphere Client or any other VMware Administration Automation Product to perform routine ESXi host configuration tasks that do not involve a troubleshooting scenario. For more information on using TSM, see the VMware Knowledge Base article (http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1003677).

The IO Accelerator installation packages include various command-line utilities, installed by default to the `/usr/bin` directory. These CLIs provide ways to access, test, and manipulate your device.

The following are the command-line utilities available in TSM or COS.

Command line utility	Purpose
fio-attach (on page 29)	Makes an IO Accelerator available to the operating system
fio-beacon (on page 30)	Lights the IO Accelerator external LEDs
fio-bugreport	Prepares a detailed report for use in troubleshooting problems
fio-detach (on page 32)	Temporarily makes the IO Accelerator unavailable to the operating system

Command line utility	Purpose
fio-format (on page 32)	Used to perform a low-level format of an IO Accelerator
fio-pci-check (ESX only)	Checks for errors on the PCI bus tree, specifically for PCIe IO Accelerator devices. This utility is only supported on ESX.
fio-status (on page 34)	Displays information about the device
fio-update-iodrive (on page 36)	Updates the IO Accelerator firmware

For more information on command-line utilities, see "Utilities (on page 29)."

Enabling PCIe power override

For PCIe IO Accelerators, if you have installed any dual IO Accelerator devices, such as the HP ioDrive2 Duo, then the device might require additional power than the minimum 25 W provided by PCIe Gen2 slots to properly function. Even if additional power is not required for your device, all dual IO Accelerator devices that receive additional power might benefit with improved performance.

HP ioDrive2 Duo devices must have additional power to properly function. For more information on which devices require additional power, see the *HP PCIe IO Accelerator for ProLiant Servers Installation Guide*.

Additional power can be provided in two ways:

- **External power cable**—This cable ships with all dual ioMemory devices. For information on installing this cable, see the *HP PCIe IO Accelerator for ProLiant Servers Installation Guide*.

  NOTE: When a power cable is used, all of the power is drawn from the cable and no power is drawn from the PCIe slot.

- **Enabling full slot power draw**—Some PCIe slots provide additional power (often up to 75 W of power). If your PCIe slot is rated to provide at least 55 W, then you can allow the device to draw full power from the PCIe slot by setting a VSL module parameter. For more information on enabling this override parameter, see "Enabling the override parameter."

  △ **CAUTION:** If the PCIe slot is not capable of providing the needed amount of power, then enabling full power draw from the PCIe slot might result in malfunction or even damage to server hardware. The user is responsible for any damage to equipment due to improper use of the override parameter. HP expressly disclaims any liability for damage arising from improper use of the override parameter. To confirm the power limits and capabilities of each slot, as well as the entire system, contact the server manufacturer. For information about using the override parameter, contact HP Customer Support.

  NOTE: The override parameter overrides the setting that prevents devices from drawing more than 25 W from the PCIe slot. The parameter is enabled by device using the device serial numbers. Once the setting is overridden, each device might draw up to the full 55 W needed for peak performance.

  Before you enable the override parameter, ensure that each PCIe slot is rated to provide enough power for all slots, devices, and server accessories. To determine the power slot limits, consult the server documentation, BIOS interface, setup utility, or use the `fio-pci-check` command.

Important considerations

- If you are installing more than one dual IO Accelerator device and enabling the override parameter for each device, be sure the motherboard is rated to provide 55W power to each slot used. For example, some motherboards safely provide up to 75W to any one slot, but run into power constraints when multiple slots are used to provide that much power. Installing multiple devices in this situation might result in server hardware damage. Consult with the manufacturer to determine the total PCIe slot power available.
- The override parameter persists in the system and enables full power draw on an enabled device even if the device is removed and then placed in a different slot within the same system. If the device is placed in a slot that is not rated to provide 55W of power, your server hardware could experience a power drag.
- The override parameter is a setting for the IO Accelerator VSL software by server and is not stored in the device. When moved to a new server, the device defaults to the 25 W power limit until an external power cable is added or the override parameter is enabled for that device in the new server. To determine the total PCIe slot power available for the new server, consult the manufacturer.

Enabling the override parameter

1. Use one of the following methods to determine the serial number of each device to be installed in a compatible slot.
   - Enter the `fio-status` command.

     Sample output:

     ```
     fio-status
     ...
     Adapter: Dual Controller Adapter
     Fusion-io ioDrive2 DUO 2.41TB, Product Number:F01-001-2T41-CS-0001, FIO
     SN:1149D0969
     External Power: NOT connected
     PCIe Power limit threshold: 24.75W
     Connected ioMemory modules:
     fct2: SN:1149D0969-1121
     fct3: SN:1149D0969-1111
     ```

     In this example, `1149D0969` is the adapter serial number.

     If you have multiple IO Accelerator devices installed on your system, use the `fio-beacon` command to verify where each device is physically located.
   - Inspect the adapter serial number labels on the IO Accelerator devices to determine the serial numbers. However, HP recommends confirming that each serial number is an adapter serial number by running the `fio-status` command. The adapter serial number label resides on the back of all HP ioDrive Duo devices and HP ioDrive2 Duo devices. On ioDrive Duos, the serial number is located on the PCB component that is attached to the PCIe connector.
2. Set the module parameter using the `esxcfg-module` command. For example:

   ```
   esxcfg-module --server <server-name> iomemory-vsl -s
   ```

   'external_power_override=<value>'

   Where the `<value>` for this parameter is a comma-separated list of adapter serial numbers. For example:

```
1149D0969,1159E0972,24589
```

NOTE: The remote option (`--server`) is only required for the vCLI.

3. Reboot the system to enable the parameter.

Common maintenance tasks

In ESX, these tasks require the COS. In ESXi, some of these maintenance tasks are only accessible through VMware TSM, also known as SSH.

IMPORTANT: VMware suggests that TSM only be used for the purposes of troubleshooting and remediation. VMware recommends using the vSphere Client or any other VMware Administration Automation Product to perform routine ESXi host configuration tasks that do not involve a troubleshooting scenario. For more information on using TSM, see the VMware Knowledge Base article (http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1003677).

Disabling the driver

By default, the driver automatically loads when the operating system starts. VMware ESX and ESXi do not allow a driver to be unloaded, so you must disable driver auto-load for diagnostic or troubleshooting purposes. For ESXi, you must run the commands in TSM.

1. To disable driver auto-load, run the following command in TSM or COS:
   ```
   $ esxcfg-module -d iomemory-vsl
   ```
2. For ESX 4.x, you must also run the following command:
   ```
   $ esxcfg-boot -b
   ```
3. Reboot the system.

Disabling driver auto-load prevents the IO Accelerator driver from loading so the device is not available to users. However, all other services and applications are still available.

Enabling the driver

To enable the IO Accelerator driver after maintenance, run the following commands, and then restart the system. For ESXi, run the commands in Tech Support Mode.

1. To enable the driver, run the following command:
   ```
   $ esxcfg-module -e iomemory-vsl
   ```
2. For ESX 4.x, you must also run the following command:
   ```
   $ esxcfg-boot -b
   ```
3. Reboot the system.

If the driver is enabled, then it appears in the modules listed when you run the following command:

```
$ esxcfg-module --query
```

Disabling auto attach

When the IO Accelerator driver is installed, it is configured to automatically attach any devices when the driver is loaded. When necessary, disable the auto attach feature.

To disable auto attach using ESX:

1. To set the auto_attach parameter to 0, run the following command:
   ```
   esxcfg-module -s 'auto_attach=0' iomemory-vsl
   ```
2. Restart the system.

To disable auto attach using ESXi:

1. To set the auto_attach parameter to 0, run the following vCLI command:
   ```
   $ vicfg-module --server <server-name> iomemory-vsl -s 'auto_attach=0'
   ```
2. Restart the system.

Enabling auto attach

To enable auto attach using ESX:

1. To set the auto_attach parameter to 1, run the following command:
   ```
   # esxcfg-module -s 'auto_attach=1' iomemory-vsl
   ```
2. Restart the system.

To enable auto attach using ESXi:

1. To set the auto_attach parameter to 1, run the following vCLI command:
   ```
   $ vicfg-module --server <server-name> iomemory-vsl -s 'auto_attach=1'
   ```
2. Restart the system.

Uninstalling the IO Accelerator driver package

Uninstalling the software in ESX 4.x

1. To find the ioMemory VSL Bulletin ID, run the following command:
   ```
   $ esxupdate query
   ```
   Sample output:
   ```
   ------Bulletin ID------ -----Installed-----
   ---------------------Summary----------------------
   iomemory-vsl-3.0.6.360 2012-01-16T03:49:33 iomemory-vsl: block driver
   for ESX/ESXi 4.X
   ```
2. Run the following command to remove VSL using its Bulletin ID:
   ```
   $ esxupdate -b <Bulletin-ID> remove
   ```

To uninstall the IO Accelerator driver package and command-line utilities run the following command:

```
$ rpm -e fio-util
```

Uninstalling the software in ESXi 4.x

To uninstall the VSL package, follow this procedure using the vCLI from a remote system:

1. To determine the bundle bulletin name, run the following command:

```
vihostupdate --server <server-name> --query
Sample output:
---------Bulletin ID---------
iomemory-vsl-2.2.0.7601742
-----Installed-----
2011-02-08T10:37:05
----------------Summary-----------------
iomemory-vsl: block driver for ESXi 4.1.X
```

2. To remove the bulletin containing the driver and utilities, run the following command:

```
vihostupdate --server <server-name> --remove --bulletin
iomemory-vsl-2.2.0.7601742
```

Uninstalling the software in ESXi 5.0

To uninstall the VSL package, follow this procedure using the vCLI from a remote system. To remove the VIB containing the driver and utilities, run the following command:

```
esxcli --server <servername> software vib remove -n block-iomemory-vsl
```

Unmanaged shutdown issues

Unmanaged shutdowns, due to power loss or other circumstances, force the IO Accelerator to perform a consistency check during the reboot. This reboot might take several minutes or more to complete and is indicated by a progress percentage during a startup.

You can cancel this consistency check by pressing **Esc** during the first 15 seconds after the **Fusion-io Consistency Check** message appears at the prompt. However, if you choose to cancel the check, the IO Accelerators remains unavailable to users until the check is completed. You can perform this check later using the IO Accelerator Management Tool **Attach** function.

Although data written to the IO Accelerator is not lost due to unmanaged shutdowns, important data structures might not have been properly committed to the drive. This consistency check repairs these data structures.

Performance and tuning

Introduction to performance and tuning

HP IO Accelerator devices provide high bandwidth and high IOPS and are specifically designed to achieve low latency.

As IO Accelerator devices improve in IOPS and low latency, the device performance may be limited by operating system settings and BIOS configuration. To take advantage of the revolutionary performance of IO Accelerator devices, you might have to tune these settings.

While IO Accelerator devices generally perform well out of the box, this section describes some of the common areas where tuning may help achieve optimal performance.

Disabling DVFS

DVFS is a power management technique that adjusts the CPU voltage and frequency to reduce power consumption by the CPU. These techniques help conserve power and reduce the heat generated by the CPU, but they adversely affect performance while the CPU transitions between low-power and high-performance states.

These power-savings techniques are known to have a negative impact on I/O latency and maximum IOPS. When tuning for maximum performance, you might benefit from reducing or disabling DVSF completely, even though this might increase power consumption.

DVFS, if available, should be configurable as part of your operating systems power management features as well as within your system BIOS interface. Within the operating system and BIOS, DVFS features are often found under the ACPI sections. Consult your computer documentation for details.

Limiting APCI C-states

Newer processors have the ability to go into lower power modes when they are not fully utilized. These idle states are known as ACPI C-states. The C0 state is the normal, full power, operating state. Higher C-states (C1, C2, C3, and so on) are lower power states.

While ACPI C-states save on power, they are known to have a negative impact on I/O latency and maximum IOPS. With each higher C-state, typically more processor functions are limited to save power, and it takes time to restore the processor to the C0 state.

These power savings techniques are known to have a negative impact on I/O latency and maximum IOPS. When tuning for maximum performance you might benefit from limiting the C-states or turning them off completely, even though this might increase power consumption.

If your processor has ACPI C-states available, you can typically limit or disable them in the BIOS interface (sometimes referred to as a Setup Utility). APCI C-states might be part of the ACPI menu. For details, see your computer documentation.

Utilities

Utilities reference

These command-line utilities are only accessible through VMware TSM, also known as SSH, on ESXi and the COS on ESX.

IMPORTANT: VMware suggests that TSM only be used for the purposes of troubleshooting and remediation. VMware recommends using the vSphere Client or any other VMware Administration Automation Product to perform routine ESXi host configuration tasks that do not involve a troubleshooting scenario. For more information on using TSM, see the VMware Knowledge Base article (http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1003677).

The VSL installation packages include various command-line utilities, installed by default to `/usr/bin`. These utilities provide a number of useful ways to access, test, and manipulate your device.

Utility	Purpose
fio-attach	Makes an IO Accelerator available to the operating system
fio-beacon	Lights the IO Accelerator external LEDs
fio-bugreport	Prepares a detailed report for use in troubleshooting problems
fio-detach	Makes an IO Accelerator unavailable to the operating system
fio-format	Used to perform a low-level format of an IO Accelerator
fio-pci-check	Checks for errors on the PCI bus tree, specifically for PCIe IO Accelerator devices. This utility is only supported on ESX.
fio-status	Displays information about the device
fio-update-iodrive	Updates the IO Accelerator firmware

NOTE: All utilities have –h (Help) and –v (Version) options.

fio-attach

The `fio-attach` utility requires the IO Accelerator driver to be loaded with auto-attach disabled. For more information, see "Disabling auto attach (on page 26)".

Description

Attaches the IO Accelerator and makes it available to the operating system. This creates a block device in `/dev/fio`. You can then add it to ESX as a storage area. The command displays a progress bar and percentage as it operates.

NOTE: If multiple IO Accelerator devices are installed in a computer, they attach in parallel.

Syntax

```
fio-attach <device> [options]
```

Where `<device>` is the name of the device node (`/dev/fctx`), where *x* indicates the card number: 0, 1, 2, and so on. For example, `/dev/fct0` indicates the first IO Accelerator installed on the system.

Options

Option	Description
`-c`	Attach only if clean.
`-q`	Quiet: disables the display of the progress bar and percentage.

In most cases, the IO Accelerator driver automatically attaches the device on load. If you need to detach the device, run the `fio-detach` command. For more information, see "fio-detach (on page 32)."

fio-beacon

Description

The `fio-beacon` utility turns on all three LEDs of the specified IO Accelerator for identification. This utility is not applicable for the mezzanine format of the IO Accelerator, which has no externally visible LEDs. You must detach the IO Accelerator, and then run the `fio-beacon` command. For more information, see "fio-detach (on page 32)."

Syntax

```
fio-beacon <device> [options]
```

Where `<device>` is the name of the device node (`/dev/fctx`), where *x* indicates the card number: 0, 1, 2, and so on. For example, `/dev/fct0` indicates the first IO Accelerator installed on the system.

Options

Option	Description
`-0`	Off: Turns off the three LEDs
`-1`	On (default): Lights the three LEDs
`-p`	Prints the PCI bus ID of the device at <device> to standard output. Usage and error information might be written to standard output rather than to standard error.

fio-bugreport

Description

Prepares a detailed report of the device for use in troubleshooting issues.

This utility captures the current state of the device. When a performance or stability problem occurs with the device, run the `fio-bugreport` utility and contact HP support (http://www.hp.com/support) for assistance in troubleshooting.

The output will indicate where the bugreport is saved.

NOTE: If the utility recommends that you contact Fusion-io support, disregard that message and contact HP support (http://www.hp.com/support) instead.

Syntax

```
fio-bugreport
```

Sample output

```
~ # fio-bugreport
VMkernel-4.1.0
Report output: /var/tmp/fio-bugreport-20111006.223733-sc07HE.tar.gz
OS: VMware-ESX-4.1.0
Collecting esxupdate query... done
Collecting dc-status -v... done
Collecting dc-status -fk... done
Collecting fio-status -a... done
Collecting fio-status -fj... done
Collecting fio-status -fj -P/dev/stdout... done
Collecting vmkload_mod -l... done
Collecting esxcfg-module -l... done
Collecting esxcfg-scsidevs -l... done
Collecting esxcfg-scsidevs -c... done
Collecting esxcfg-scsidevs -u... done
Collecting esxcfg-scsidevs -m... done
Collecting esxcfg-scsidevs -a... done
Collecting esxcfg-info ... done
Collecting vm-support ... done
Collecting system file(s)... done
Collecting vib-env ... done
Collecting lspci ... done
Collecting lspci -p... done
Collecting lspci -vd... done
Collecting vmkchkdev -L... done
Collecting df -k... done
Collecting vdf ... done
Collecting cim-diagnostic.sh ... done
Building tar file...
Please attach the bugreport tar file
    /var/tmp/fio-bugreport-20111006.173256-sc07HE.tar.gz
  to your support case, including steps to reproduce the problem,
    and upload or email to customer support.
```

For example, the filename for a bug report file named `fio-bugreport-20111006.173256-sc07HE.tar.gz` indicates the following:

- Date (20111006)
- Time (173256, or 17:32:56)
- Misc. information (sc07HE.tar.gz)

fio-detach

CAUTION: Before using this utility, be sure that the IO Accelerator to be detached is not currently mounted or otherwise in use (for example, as a datastore). The driver cannot determine whether the drive is in use at the time of detaching. Detaching a drive while it is in use might cause errors, data loss, and corruption.

The `fio-detach` utility detaches the IO Accelerator from the operating system one device at a time. By default, the command displays a progress bar and percentage as it completes the process.

Syntax

```
fio-detach <device> [options]
```

where `<device>` is the name of the device node (`/dev/fctx`), where x indicates the card number: 0, 1, 2, and so on. For example, `/dev/fct0` indicates the first IO Accelerator installed on the system.

Options

Option	Description
-i	Immediate: Causes a forced, immediate detach (does not save metadata). This command will fail if the device is in use by the operating system.
-q	Quiet: Disables the display of the progress bar and percentage.

With version 2.0 and later of the driver, attempting to detach an IO Accelerator might fail with an error indicating that the device is busy. This error typically might occur if the IO Accelerator is in use by VM or other process, or some process has the device open.

fio-format

You must detach the IO Accelerator before running this command. For more information, see "fio-detach (on page 32)."

Description

The `fio-format` command performs a low-level format of the IO Accelerator. This format is different from a format performed by the operating system. The utility displays a progress bar and percentage as it completes the format.

The IO Accelerator ships pre-formatted, so you only have to run the `fio-format` command if you need to change the logical size of the device.

CAUTION: Use this utility with care since it deletes all user information on the IO Accelerator.

NOTE: VMFS, the default filesystem employed by ESX, requires a 512-byte sector size.

Syntax

```
fio-format [options] <device>
```

where <device> is the name of the device node (/dev/fctx), where *x* indicates the card number: 0, 1, 2, and so on. For example, /dev/fct0 indicates the first IO Accelerator installed on the system.

Options

NOTE: ESX only supports 512 byte sector sizes for use in VMDKs. Do not format your IO Accelerator device with any other sector size if you plan to use VMDKs. If you are passing the device through to a VM using PCI pass-through, then the guest VM can use any sector size appropriate for the guest operating system. In this case, formatting is performed on the guest system.

Option	Description
-b <size B|K>	Sets the block (sector) size, in bytes or KiBytes (base 2). The default is 512 bytes. For example: -b 512B or -b 4K (B in 512B is optional).
-f	Forces the format size, bypassing normal checks and warnings. This option might be needed in rare situations when the fio-format command does not proceed properly. (The **Are you sure?** prompt still appears unless you use the -y option.)
-q	Quiet mode: Disables the display of the progress-percentage indicator.
-s <size B|K|M|G|T|%>	Sets the device capacity as a specific size (in TB, GB, or MB) or as a percentage of the advertised capacity: • T—The number of terabytes (TB) to format • G—The number of gigabytes (GB) to format • M—The number of megabytes (MB) to format • %—The percentage, such as 70% (the percent sign must be included)
-o <size B|K|M|G|T|%>	Over-formats the device size to greater than the advertised capacity, where the maximum size equals the maximum physical capacity. If a percentage is used, it corresponds to the maximum physical capacity of the device. Size is required for the -o option. For size indicator descriptions, see the previously described -s option.
-r	Enables fast rescan on unclean shutdowns at the cost of some capacity.
-y	Auto-answers **yes** to all queries from the application, bypassing prompts.

You must re-attach the driver to use the IO Accelerator. For more information, see "fio-attach (on page 29)."

fio-pci-check

The fio-pci-check utility is only supported on ESX. If you run it on an ESXi host, it will print the following message:

This utility is not supported on ESXi.

Description

The fio-pci-check utility checks for errors on the PCI bus tree, specifically for IO Accelerator devices. This utility displays the current status of each IO Accelerator device. It also prints the standard PCIe error information and resets the state.

It is normal to see as many as five errors when fio-pci-check is initially run. Subsequent runs should reveal only one or two errors during several hours of operation.

Syntax

```
fio-pci-check [options]
```

Options	Description
-d <value>	1 = Disable the link; 0 = bring the link up (HP does not recommend this parameter)
-f	Scan every device in the system.
-i	Print the device serial number. This option is invalid when the VSL is loaded.
-r	Force the link to retrain.
-v	Verbose: Print extra data about the hardware.

fio-status

Description

The `fio-status` command provides detailed information about the specified or all installed IO Accelerators. This utility operates on `/dev/fctx` devices. The `fio-status` command must run with root privileges and requires that the driver be loaded. If no driver is loaded, a smaller set of status information is returned.

The `fio-status` command provides alerts for certain error modes, such as a minimal-mode, read-only mode, and write-reduced mode, describing what is causing the condition.

Syntax

```
fio-status <device> [options]
```

where `<device>` is the name of the device node (`/dev/fctx`), where *x* indicates the card number: `0`, `1`, `2`, and so on. For example, `/dev/fct0` indicates the first IO Accelerator installed on the system.

If `<device>` is not specified, the `fio-status` command displays information for all IO Accelerator devices in the system. If the driver is not loaded, this parameter is ignored.

Options

Option	Description
`-a`	Reports all available information for each device.
`-e`	Shows all errors and warnings for each device. This option is for diagnosing issues, and it hides other information such as format sizes.
`-c`	Count: Reports only the number of IO Accelerator devices installed.
`-d`	Shows basic information set plus the total amount of data read and written (lifetime data volumes). This option is not necessary when the `-a` option is used.
`-fj`	Format JSON: Creates the output in JSON format.
`-fx`	Format XML: Creates the output in XML format.
`-u`	Shows unavailable fields. Only valid with `-fj` or `-fx`.
`-U`	Shows unavailable fields and details why the fields are unavailable. Only valid with `-fj` or `-fx`.
`-F<field>`	Prints the value for a single field (see the `-l` option for field names). Requires that a device be specified. Multiple `-F` options can be specified.
`-l`	Lists the fields that can be individually accessed with `-F`.

IMPORTANT: Starting with version 3.0.0 and later, the standard formatting of the `fio-status` output changed. The changing of the format affects any custom management tools that used the output of this utility.

Basic information

If no options are used, the `fio-status` command reports the following basic information:

- Number and type of devices installed in the system
- Driver version

Adapter information

- Adapter type
- Product number
- External power status
- PCI power limit threshold (if available)
- Connected IO Accelerator devices

Block device information:

- Attach status
- Product name
- Product number
- Serial number
- PCIe address and slot
- Firmware version
- Size of the device, out of total capacity
- Internal temperature (average and maximum, since driver load) in degrees Celsius
- Health status: healthy, nearing wearout, write-reduced, or read-only
- Reserve capacity (percentage)
- Warning capacity threshold (percentage)

Data volume information

If the `-d` option is used, the following data volume information is reported in addition to the basic information:

- Physical bytes written
- Physical bytes read

All information

If the `-a` option is used, all information is printed, which includes the following information in addition to basic and data volume information:

- Adapter information
  - Manufacturer number
  - Part number

- Date of manufacture
- Power loss protection status
- PCIe bus voltage (average, minimum, maximum)
- PCIe bus current (average, maximum)
- PCIe bus power (average, maximum
- PCIe power limit threshold (watts)
- PCIe slot available power (watts)
- PCIe negotiated link information (lanes and throughput)

- Block device information
  - Manufacturer code
  - Manufacturing date
  - Vendor and sub-vendor information
  - Format status and sector information (if device is attached)
  - FPGA ID and Low-level format GUID
  - PCIe slot available power
  - PCIe negotiated link information
  - Card temperature, in degrees Centigrade
  - Internal voltage, average and maximum
  - Auxiliary voltage, average and maximum
  - Percentage of good blocks, data and metadata
  - Lifetime data volume statistics
  - RAM usage

Error mode information

If the IO Accelerator driver is in minimal mode, read-only mode, or write-reduced mode when the `fio-status` command is run, the following differences occur in the output:

- Attach status is **Status unknown: Driver is in MINIMAL MODE**
- The reason for the minimal mode state appears. (For example, `Firmware is out of date. Update firmware`.)
- `Geometry and capacity information not available` appears.
- No media health information appears.

fio-update-iodrive

Description

IMPORTANT: The IO Accelerator devices must be detached before running the `fio-update-iodrive` command. To detach the devices requires rebooting with auto-attach disabled or using `fio-detach`. For details, see "fio-detach (on page 32)."

The `fio-update-iodrive` utility updates the HP IO Accelerator firmware. This utility scans the PCI-Express bus for all HP IO Accelerators and updates them all sequentially.

To ensure a clean firmware update, you must detach the device from the system using the `fio-detach` utility. For more information, see "fio-detach (on page 32)".

To update one or more specific drives (rather than all drives):

- Make sure the IO Accelerator driver is loaded.
- Use the `-d` option with the device number.

CAUTION: Do not turn off the power during a firmware upgrade, because this might cause device failure. If a UPS is not in place, consider adding one to the system before performing a firmware upgrade.

CAUTION: When running multiple upgrades in sequence (such as going from driver version 1.2.1 to 1.2.4 to 2.2.2), you must reboot the system after each firmware upgrade step. Otherwise the on-drive format does not change, and data loss occurs.

CAUTION: Do not use this utility to downgrade the IO Accelerator to an earlier version of the firmware. Doing so might result in data loss. If you need to downgrade your firmware, contact HP customer support. For more information, see "Technical support."

NOTE: If you receive an error message when updating the firmware instructing you to update the midprom information, contact Customer Support. For more information, see "Technical support."

NOTE: If you upgrade the firmware on an IO Accelerator when using PCI pass-through, you must cycle the power to apply the change. Restarting the VM does not apply the change.

The default action (without using the `-d` option) is to upgrade all IO Accelerators with the firmware contained in the `<iodrive_version.fff>` file. Confirm that all devices need the upgrade prior to running the update. If in doubt, use the `-p` (Pretend) option to view the possible results of the update.

Syntax

```
fio-update-iodrive [options] <iodrive_version.fff>
```

where `<iodrive_version.fff>` is the path and firmware archive file. You must transfer the firmware archive file to the ESX host (this must be a local path to the host) before you run the update.

All three external LED indicators light up during the update process.

Command	Description
`-d`	Updates the specified devices (by `fctx`, where `x` is the number of the device shown in `fio-status`). If this option is not specified, all devices are updated.
`-f`	Forces upgrade. Used primarily to downgrade to an earlier firmware version.
`-l`	Lists firmware available in the archive.
`-p`	Pretend. Shows what updates are done. The firmware is not modified.
`-c`	Clears locks placed on a device.
`-q`	Runs the update process without displaying the progress bar or percentage.
`-y`	Confirm all warning messages.

△ **CAUTION:** Use the `-f` option with care because it might damage your board.

△ **CAUTION:** Use the `{{-d}}` option with care, because updating the wrong device might damage the device.

Monitoring IO Accelerator health

NAND flash and component failure

The IO Accelerator is a highly fault-tolerant storage subsystem that provides many levels of protection against component failure and the loss nature of solid state storage. However, as in all storage subsystems, component failures might occur.

When a large enough number of data blocks is retired due to error, the NAND flash media is considered worn out. By properly selecting NAND flash media for the hosted application and proactively monitoring device age and health, you can assure reliable performance over the intended product life.

Health metrics

The IO Accelerator driver manages block retirement using pre-determined retirement thresholds. The `fio-status` utility show a health indicator that starts at 100 and counts down to 0. As certain thresholds are crossed, various actions are taken.

At the 10% healthy threshold, a one-time warning is issued. For methods on capturing this alarm event, see "Health monitoring techniques (on page 39)."

At 0%, the device is considered unhealthy. It enters write-reduced mode, which somewhat prolongs its lifespan so data can be safely migrated. In this state, the IO Accelerator behaves normally except for the reduced write performance.

At some point after the 0% threshold, the device enters read-only mode. Any attempt to write to the IO Accelerator causes an error. Some file systems might require special mount options to mount a read-only block device, beyond specifying that the mount should be read-only.

Consider the read-only mode as a final opportunity to migrate data off the device since device failure is more likely with continued use.

The IO Accelerator might enter failure mode. In this case, the device is offline and inaccessible. Failure mode can be caused by an internal catastrophic failure, improper firmware upgrade procedures, or device wears out.

Health monitoring techniques

Output from the `fio-status` utility shows the health percentage and drive state. These items are referenced as `Media Status` in the following sample output.

```
Found 1 ioDrive in this system
Fusion-io driver version: 2.2.3 build 240
Adapter: ioDrive
Fusion-io ioDrive 160GB, Product Number:FS1-002-161-ES
...
Media status: Healthy; Reserves: 100.00%, warn at 10.00%; Data: 99.12%
```

```
Lifetime data volumes:
     Physical bytes written: 6,423,563,326,064
     Physical bytes read : 5,509,006,756,312
```

Flashback substitution events

The IO Accelerator is equipped with Flashback substitution capability. This capability allows for predictive NAND flash failures to occur and keep the IO Accelerator functioning by substituting out bad locations or even a whole NAND chip. The output of the `fio-status -a` command will show if any flashback substitution events have occurred.

The following is an example of the output after entering the `fio-status -a` command. The numbers represent the bank (0-3) and chip number that was substituted.

```
First flashback event -> No action to take as infant mortality condition on NAND chip was caught per design.

Second flashback event -> Run fio-bugreport. Return the card (if under warranty) when you see two or more flashback substitution events.
```

- `Flashback active on (bank a/chip m) and (bank b/chip n)` (multi-bank failure)
- `Flashback active on (bank a/chip m) and (bank b/chip m)` (chip failure)

On the second flashback event, include the output from running the `fio-bugreport` command when you return the card.

Module parameters

Using module parameters

The following table describes the module parameters you can set using the `esxcfg-module` command.

The remote option (`--server`) is only required for the vCLI.

Sample command:

```
esxcfg-module --server <server-name> iomemory-vsl -s '<parameter>=<value>'
```

You must reboot the ESX or ESXi system to enforce any parameter changes.

Module parameter	Default (min/max)	Description
`auto_attach`	1	1 = Always attach the device on startup. 0 = Do not attach the device on startup.
external_power_override*	No devices selected	Allows selected devices to draw full power from the PCIe slot. The `<value>` for this parameter is a comma-separated list of adapter serial numbers.
`force_minimal_mode`	0	1 = Force minimal mode on the device. 0 = Do not force minimal mode on the device.
`parallel_attach`	True	1 = Enable parallel attach of multiple drivers. 0 = Disable parallel attach of multiple drives.
`tintr_hw_wait`	0 (0, 255)	Interval (microseconds) to wait between hardware interrupts. Also known as interrupt coalescing. 0 = Off.

*Use this parameter with care. For more information, see "Enabling PCIe power override (on page 23)."

Except for the `external_power_override` parameter, module parameters apply to all IO Accelerator devices in the system.

To query the current module parameters, use the following command:

```
esxcfg-module --server <server-name> iomemory-vsl -g
```

VMDirectPathIO

Working with IO Accelerators and VMDirectPathIO

Each IO Accelerator device can either be used as a VMFS datastore in ESX or ESXi, or it can be passed through directly to a VM. In VMware documentation, passing through to a VM this is referred to as VMDirectPathIO.

If you are passing the devices through, you do not have to install the VSL on the ESX or ESXi system. Instead, install the software on the guest system. Install the driver only if you plan to create a VMFS on the devices.

When using VMDirectPathIO, if you upgrade the firmware on an IO Accelerator device, you must cycle the power to have the change take place. Restarting the VM will not apply the change.

Using products with multiple devices

Some products, such as the HP IO Accelerator ioDrive Duo, contain multiple devices. The VSL does not support splitting the modules between two functions or VMs. The following scenarios are supported:

- Both IO Accelerator devices are used as a VMFS datastore in ESX or ESXi.
- Both IO Accelerator devices are passed through to the same VM using VMDirectPathIO.

Resources

Subscription service

HP recommends that you register your product at the Subscriber's Choice for Business website (http://www.hp.com/support).

After registering, you will receive e-mail notification of product enhancements, new driver versions, firmware updates, and other product resources.

For more information

For additional information, see the following HP websites:

- HP BladeSystem technical resources (http://www.hp.com/go/bladesystem/documentation) (white papers and support documents)
- HP BladeSystem components (http://h18004.www1.hp.com/products/blades/components/c-class-compmatrix.html)
- HP support (http://www.hp.com/support)

Support and other resources

Before you contact HP

Be sure to have the following information available before you call HP:

- Active Health System log

  Download and have available an Active Health System log for 3 days before the failure was detected. For more information, see the *HP iLO 4 User Guide* or *HP Intelligent Provisioning User Guide* on the HP website (http://www.hp.com/go/ilo/docs).

- Onboard Administrator SHOW ALL report (for HP BladeSystem products only)

  For more information on obtaining the Onboard Administrator SHOW ALL report, see the HP website (http://h20000.www2.hp.com/bizsupport/TechSupport/Document.jsp?lang=en&cc=us&objectID=c02843807).

- Technical support registration number (if applicable)
- Product serial number
- Product model name and number
- Product identification number
- Applicable error messages
- Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level

HP contact information

For United States and worldwide contact information, see the Contact HP website (http://www.hp.com/go/assistance).

In the United States:

- To contact HP by phone, call 1-800-334-5144. For continuous quality improvement, calls may be recorded or monitored.
- If you have purchased a Care Pack (service upgrade), see the Support & Drivers website (http://www8.hp.com/us/en/support-drivers.html). If the problem cannot be resolved at the website, call 1-800-633-3600. For more information about Care Packs, see the HP website (http://pro-aq-sama.houston.hp.com/services/cache/10950-0-0-225-121.html).

Customer Self Repair

HP products are designed with many Customer Self Repair (CSR) parts to minimize repair time and allow for greater flexibility in performing defective parts replacement. If during the diagnosis period HP (or HP service

providers or service partners) identifies that the repair can be accomplished by the use of a CSR part, HP will ship that part directly to you for replacement. There are two categories of CSR parts:

- **Mandatory**—Parts for which customer self repair is mandatory. If you request HP to replace these parts, you will be charged for the travel and labor costs of this service.
- **Optional**—Parts for which customer self repair is optional. These parts are also designed for customer self repair. If, however, you require that HP replace them for you, there may or may not be additional charges, depending on the type of warranty service designated for your product.

NOTE: Some HP parts are not designed for customer self repair. In order to satisfy the customer warranty, HP requires that an authorized service provider replace the part. These parts are identified as "No" in the Illustrated Parts Catalog.

Based on availability and where geography permits, CSR parts will be shipped for next business day delivery. Same day or four-hour delivery may be offered at an additional charge where geography permits. If assistance is required, you can call the HP Technical Support Center and a technician will help you over the telephone. HP specifies in the materials shipped with a replacement CSR part whether a defective part must be returned to HP. In cases where it is required to return the defective part to HP, you must ship the defective part back to HP within a defined period of time, normally five (5) business days. The defective part must be returned with the associated documentation in the provided shipping material. Failure to return the defective part may result in HP billing you for the replacement. With a customer self repair, HP will pay all shipping and part return costs and determine the courier/carrier to be used.

For more information about HP's Customer Self Repair program, contact your local service provider. For the North American program, refer to the HP website (http://www.hp.com/go/selfrepair).

Réparation par le client (CSR)

Les produits HP comportent de nombreuses pièces CSR (Customer Self Repair = réparation par le client) afin de minimiser les délais de réparation et faciliter le remplacement des pièces défectueuses. Si pendant la période de diagnostic, HP (ou ses partenaires ou mainteneurs agréés) détermine que la réparation peut être effectuée à l'aide d'une pièce CSR, HP vous l'envoie directement. Il existe deux catégories de pièces CSR:

Obligatoire - Pièces pour lesquelles la réparation par le client est obligatoire. Si vous demandez à HP de remplacer ces pièces, les coûts de déplacement et main d'œuvre du service vous seront facturés.

Facultatif - Pièces pour lesquelles la réparation par le client est facultative. Ces pièces sont également conçues pour permettre au client d'effectuer lui-même la réparation. Toutefois, si vous demandez à HP de remplacer ces pièces, l'intervention peut ou non vous être facturée, selon le type de garantie applicable à votre produit.

REMARQUE: Certaines pièces HP ne sont pas conçues pour permettre au client d'effectuer lui-même la réparation. Pour que la garantie puisse s'appliquer, HP exige que le remplacement de la pièce soit effectué par un Mainteneur Agréé. Ces pièces sont identifiées par la mention "Non" dans le Catalogue illustré.

Les pièces CSR sont livrées le jour ouvré suivant, dans la limite des stocks disponibles et selon votre situation géographique. Si votre situation géographique le permet et que vous demandez une livraison le jour même ou dans les 4 heures, celle-ci vous sera facturée. Pour bénéficier d'une assistance téléphonique, appelez le Centre d'assistance technique HP. Dans les documents envoyés avec la pièce de rechange CSR, HP précise s'il est nécessaire de lui retourner la pièce défectueuse. Si c'est le cas, vous devez le faire dans le délai indiqué, généralement cinq (5) jours ouvrés. La pièce et sa documentation doivent être retournées dans l'emballage fourni. Si vous ne retournez pas la pièce défectueuse, HP se réserve le droit de vous facturer les coûts de remplacement. Dans le cas d'une pièce CSR, HP supporte l'ensemble des frais d'expédition et de retour, et détermine la société de courses ou le transporteur à utiliser.

Pour plus d'informations sur le programme CSR de HP, contactez votre Mainteneur Agrée local. Pour plus d'informations sur ce programme en Amérique du Nord, consultez le site Web HP (http://www.hp.com/go/selfrepair).

Riparazione da parte del cliente

Per abbreviare i tempi di riparazione e garantire una maggiore flessibilità nella sostituzione di parti difettose, i prodotti HP sono realizzati con numerosi componenti che possono essere riparati direttamente dal cliente (CSR, Customer Self Repair). Se in fase di diagnostica HP (o un centro di servizi o di assistenza HP) identifica il guasto come riparabile mediante un ricambio CSR, HP lo spedirà direttamente al cliente per la sostituzione. Vi sono due categorie di parti CSR:

Obbligatorie – Parti che devono essere necessariamente riparate dal cliente. Se il cliente ne affida la riparazione ad HP, deve sostenere le spese di spedizione e di manodopera per il servizio.

Opzionali – Parti la cui riparazione da parte del cliente è facoltativa. Si tratta comunque di componenti progettati per questo scopo. Se tuttavia il cliente ne richiede la sostituzione ad HP, potrebbe dover sostenere spese addizionali a seconda del tipo di garanzia previsto per il prodotto.

NOTA: alcuni componenti HP non sono progettati per la riparazione da parte del cliente. Per rispettare la garanzia, HP richiede che queste parti siano sostituite da un centro di assistenza autorizzato. Tali parti sono identificate da un "No" nel Catalogo illustrato dei componenti.

In base alla disponibilità e alla località geografica, le parti CSR vengono spedite con consegna entro il giorno lavorativo seguente. La consegna nel giorno stesso o entro quattro ore è offerta con un supplemento di costo solo in alcune zone. In caso di necessità si può richiedere l'assistenza telefonica di un addetto del centro di supporto tecnico HP. Nel materiale fornito con una parte di ricambio CSR, HP specifica se il cliente deve restituire dei componenti. Qualora sia richiesta la resa ad HP del componente difettoso, lo si deve spedire ad HP entro un determinato periodo di tempo, generalmente cinque (5) giorni lavorativi. Il componente difettoso deve essere restituito con la documentazione associata nell'imballo di spedizione fornito. La mancata restituzione del componente può comportare la fatturazione del ricambio da parte di HP. Nel caso di riparazione da parte del cliente, HP sostiene tutte le spese di spedizione e resa e sceglie il corriere/vettore da utilizzare.

Per ulteriori informazioni sul programma CSR di HP contattare il centro di assistenza di zona. Per il programma in Nord America fare riferimento al sito Web HP (http://www.hp.com/go/selfrepair).

Customer Self Repair

HP Produkte enthalten viele CSR-Teile (Customer Self Repair), um Reparaturzeiten zu minimieren und höhere Flexibilität beim Austausch defekter Bauteile zu ermöglichen. Wenn HP (oder ein HP Servicepartner) bei der Diagnose feststellt, dass das Produkt mithilfe eines CSR-Teils repariert werden kann, sendet Ihnen HP dieses Bauteil zum Austausch direkt zu. CSR-Teile werden in zwei Kategorien unterteilt:

Zwingend – Teile, für die das Customer Self Repair-Verfahren zwingend vorgegeben ist. Wenn Sie den Austausch dieser Teile von HP vornehmen lassen, werden Ihnen die Anfahrt- und Arbeitskosten für diesen Service berechnet.

Optional – Teile, für die das Customer Self Repair-Verfahren optional ist. Diese Teile sind auch für Customer Self Repair ausgelegt. Wenn Sie jedoch den Austausch dieser Teile von HP vornehmen lassen möchten, können bei diesem Service je nach den für Ihr Produkt vorgesehenen Garantiebedingungen zusätzliche Kosten anfallen.

HINWEIS: Einige Teile sind nicht für Customer Self Repair ausgelegt. Um den Garantieanspruch des Kunden zu erfüllen, muss das Teil von einem HP Servicepartner ersetzt werden. Im illustrierten Teilekatalog sind diese Teile mit „No“ bzw. „Nein“ gekennzeichnet.

CSR-Teile werden abhängig von der Verfügbarkeit und vom Lieferziel am folgenden Geschäftstag geliefert. Für bestimmte Standorte ist eine Lieferung am selben Tag oder innerhalb von vier Stunden gegen einen Aufpreis verfügbar. Wenn Sie Hilfe benötigen, können Sie das HP technische Support Center anrufen und sich von einem Mitarbeiter per Telefon helfen lassen. Den Materialien, die mit einem CSR-Ersatzteil geliefert werden, können Sie entnehmen, ob das defekte Teil an HP zurückgeschickt werden muss. Wenn es erforderlich ist, das defekte Teil an HP zurückzuschicken, müssen Sie dies innerhalb eines vorgegebenen Zeitraums tun, in der Regel innerhalb von fünf (5) Geschäftstagen. Das defekte Teil muss mit der zugehörigen Dokumentation in der Verpackung zurückgeschickt werden, die im Lieferumfang enthalten ist. Wenn Sie das defekte Teil nicht zurückschicken, kann HP Ihnen das Ersatzteil in Rechnung stellen. Im Falle von Customer Self Repair kommt HP für alle Kosten für die Lieferung und Rücksendung auf und bestimmt den Kurier-/Frachtdienst.

Weitere Informationen über das HP Customer Self Repair Programm erhalten Sie von Ihrem Servicepartner vor Ort. Informationen über das CSR-Programm in Nordamerika finden Sie auf der HP Website unter (http://www.hp.com/go/selfrepair).

Reparaciones del propio cliente

Los productos de HP incluyen muchos componentes que el propio usuario puede reemplazar (*Customer Self Repair*, CSR) para minimizar el tiempo de reparación y ofrecer una mayor flexibilidad a la hora de realizar sustituciones de componentes defectuosos. Si, durante la fase de diagnóstico, HP (o los proveedores o socios de servicio de HP) identifica que una reparación puede llevarse a cabo mediante el uso de un componente CSR, HP le enviará dicho componente directamente para que realice su sustitución. Los componentes CSR se clasifican en dos categorías:

- **Obligatorio:** componentes para los que la reparación por parte del usuario es obligatoria. Si solicita a HP que realice la sustitución de estos componentes, tendrá que hacerse cargo de los gastos de desplazamiento y de mano de obra de dicho servicio.
- **Opcional:** componentes para los que la reparación por parte del usuario es opcional. Estos componentes también están diseñados para que puedan ser reparados por el usuario. Sin embargo, si precisa que HP realice su sustitución, puede o no conllevar costes adicionales, dependiendo del tipo de servicio de garantía correspondiente al producto.

NOTA: Algunos componentes no están diseñados para que puedan ser reparados por el usuario. Para que el usuario haga valer su garantía, HP pone como condición que un proveedor de servicios autorizado realice la sustitución de estos componentes. Dichos componentes se identifican con la palabra "No" en el catálogo ilustrado de componentes.

Según la disponibilidad y la situación geográfica, los componentes CSR se enviarán para que lleguen a su destino al siguiente día laborable. Si la situación geográfica lo permite, se puede solicitar la entrega en el mismo día o en cuatro horas con un coste adicional. Si precisa asistencia técnica, puede llamar al Centro de asistencia técnica de HP y recibirá ayuda telefónica por parte de un técnico. Con el envío de materiales para la sustitución de componentes CSR, HP especificará si los componentes defectuosos deberán devolverse a HP. En aquellos casos en los que sea necesario devolver algún componente a HP, deberá hacerlo en el periodo de tiempo especificado, normalmente cinco días laborables. Los componentes defectuosos deberán devolverse con toda la documentación relacionada y con el embalaje de envío. Si no enviara el componente defectuoso requerido, HP podrá cobrarle por el de sustitución. En el caso de todas

sustituciones que lleve a cabo el cliente, HP se hará cargo de todos los gastos de envío y devolución de componentes y escogerá la empresa de transporte que se utilice para dicho servicio.

Para obtener más información acerca del programa de Reparaciones del propio cliente de HP, póngase en contacto con su proveedor de servicios local. Si está interesado en el programa para Norteamérica, visite la página web de HP siguiente (http://www.hp.com/go/selfrepair).

Customer Self Repair

Veel onderdelen in HP producten zijn door de klant zelf te repareren, waardoor de reparatieduur tot een minimum beperkt kan blijven en de flexibiliteit in het vervangen van defecte onderdelen groter is. Deze onderdelen worden CSR-onderdelen (Customer Self Repair) genoemd. Als HP (of een HP Service Partner) bij de diagnose vaststelt dat de reparatie kan worden uitgevoerd met een CSR-onderdeel, verzendt HP dat onderdeel rechtstreeks naar u, zodat u het defecte onderdeel daarmee kunt vervangen. Er zijn twee categorieën CSR-onderdelen:

Verplicht: Onderdelen waarvoor reparatie door de klant verplicht is. Als u HP verzoekt deze onderdelen voor u te vervangen, worden u voor deze service reiskosten en arbeidsloon in rekening gebracht.

Optioneel: Onderdelen waarvoor reparatie door de klant optioneel is. Ook deze onderdelen zijn ontworpen voor reparatie door de klant. Als u echter HP verzoekt deze onderdelen voor u te vervangen, kunnen daarvoor extra kosten in rekening worden gebracht, afhankelijk van het type garantieservice voor het product.

OPMERKING: Sommige HP onderdelen zijn niet ontwikkeld voor reparatie door de klant. In verband met de garantievoorwaarden moet het onderdeel door een geautoriseerde Service Partner worden vervangen. Deze onderdelen worden in de geïllustreerde onderdelencatalogus aangemerkt met "Nee".

Afhankelijk van de leverbaarheid en de locatie worden CSR-onderdelen verzonden voor levering op de eerstvolgende werkdag. Levering op dezelfde dag of binnen vier uur kan tegen meerkosten worden aangeboden, indien dit mogelijk is gezien de locatie. Indien assistentie gewenst is, belt u een HP Service Partner om via de telefoon technische ondersteuning te ontvangen. HP vermeldt in de documentatie bij het vervangende CSR-onderdeel of het defecte onderdeel aan HP moet worden geretourneerd. Als het defecte onderdeel aan HP moet worden teruggezonden, moet u het defecte onderdeel binnen een bepaalde periode, gewoonlijk vijf (5) werkdagen, retourneren aan HP. Het defecte onderdeel moet met de bijbehorende documentatie worden geretourneerd in het meegeleverde verpakkingsmateriaal. Als u het defecte onderdeel niet terugzendt, kan HP u voor het vervangende onderdeel kosten in rekening brengen. Bij reparatie door de klant betaalt HP alle verzendkosten voor het vervangende en geretourneerde onderdeel en kiest HP zelf welke koerier/transportonderneming hiervoor wordt gebruikt.

Neem contact op met een Service Partner voor meer informatie over het Customer Self Repair programma van HP. Informatie over Service Partners vindt u op de HP website (http://www.hp.com/go/selfrepair).

Reparo feito pelo cliente

Os produtos da HP são projetados com muitas peças para reparo feito pelo cliente (CSR) de modo a minimizar o tempo de reparo e permitir maior flexibilidade na substituição de peças com defeito. Se, durante o período de diagnóstico, a HP (ou fornecedores/parceiros de serviço da HP) concluir que o reparo pode ser efetuado pelo uso de uma peça CSR, a peça de reposição será enviada diretamente ao cliente. Existem duas categorias de peças CSR:

Obrigatória – Peças cujo reparo feito pelo cliente é obrigatório. Se desejar que a HP substitua essas peças, serão cobradas as despesas de transporte e mão-de-obra do serviço.

Opcional – Peças cujo reparo feito pelo cliente é opcional. Essas peças também são projetadas para o reparo feito pelo cliente. No entanto, se desejar que a HP as substitua, pode haver ou não a cobrança de taxa adicional, dependendo do tipo de serviço de garantia destinado ao produto.

OBSERVAÇÃO: Algumas peças da HP não são projetadas para o reparo feito pelo cliente. A fim de cumprir a garantia do cliente, a HP exige que um técnico autorizado substitua a peça. Essas peças estão identificadas com a marca "No" (Não), no catálogo de peças ilustrado.

Conforme a disponibilidade e o local geográfico, as peças CSR serão enviadas no primeiro dia útil após o pedido. Onde as condições geográficas permitirem, a entrega no mesmo dia ou em quatro horas pode ser feita mediante uma taxa adicional. Se precisar de auxílio, entre em contato com o Centro de suporte técnico da HP para que um técnico o ajude por telefone. A HP especifica nos materiais fornecidos com a peça CSR de reposição se a peça com defeito deve ser devolvida à HP. Nos casos em que isso for necessário, é preciso enviar a peça com defeito à HP dentro do período determinado, normalmente cinco (5) dias úteis. A peça com defeito deve ser enviada com a documentação correspondente no material de transporte fornecido. Caso não o faça, a HP poderá cobrar a reposição. Para as peças de reparo feito pelo cliente, a HP paga todas as despesas de transporte e de devolução da peça e determina a transportadora/serviço postal a ser utilizado.

Para obter mais informações sobre o programa de reparo feito pelo cliente da HP, entre em contato com o fornecedor de serviços local. Para o programa norte-americano, visite o site da HP (http://www.hp.com/go/selfrepair).

顧客自己修理保証サービス

修理時間を短縮し、故障部品の交換における高い柔軟性を確保するために、HP製品には多数の顧客自己修理（CSR）部品があります。診断の際に、CSR部品を使用すれば修理ができるとHP（HPまたはHP正規保守代理店）が判断した場合、HPはその部品を直接、お客様に発送し、お客様に交換していただきます。CSR部品には以下の2通りがあります。

- 必須 - 顧客自己修理が必須の部品。当該部品について、もしもお客様がHPに交換作業を依頼される場合には、その修理サービスに関する交通費および人件費がお客様に請求されます。
- 任意 - 顧客自己修理が任意である部品。この部品も顧客自己修理用です。当該部品について、もしもお客様がHPに交換作業を依頼される場合には、お買い上げの製品に適用される保証サービス内容の範囲内においては、別途費用を負担していただくことなく保証サービスを受けることができます。

注： HP製品の一部の部品は、顧客自己修理用ではありません。製品の保証を継続するためには、HPまたはHP正規保守代理店による交換作業が必須となります。部品カタログには、当該部品が顧客自己修理除外品である旨が記載されています。

部品供給が可能な場合、地域によっては、CSR部品を翌営業日に届くように発送します。また、地域によっては、追加費用を負担いただくことにより同日または4時間以内に届くように発送することも可能な場合があります。サポートが必要なときは、HPの修理受付窓口に電話していただければ、技術者が電話でアドバイスします。交換用のCSR部品または同梱物には、故障部品をHPに返送する必要があるかどうかが表示されています。故障部品をHPに返送する必要がある場合は、指定期限内（通常は5営業日以内）に故障部品をHPに返送してください。故障部品を返送する場合は、届いた時の梱包箱に関連書類とともに入れてください。故障部品を返送しない場合、HPから部品費用が請求されます。顧客自己修理の際には、HPは送料および部品返送費を全額負担し、使用する宅配便会社や運送会社を指定します。

客户自行维修

HP 产品提供许多客户自行维修 (CSR) 部件，以尽可能缩短维修时间和在更换缺陷部件方面提供更大的灵活性。如果在诊断期间 HP（或 HP 服务提供商或服务合作伙伴）确定可以通过使用 CSR 部件完成维修，HP 将直接把该部件发送给您进行更换。有两类 CSR 部件：

- **强制性的** — 要求客户必须自行维修的部件。如果您请求 HP 更换这些部件，则必须为该服务支付差旅费和人工费用。
- **可选的** — 客户可以选择是否自行维修的部件。这些部件也是为客户自行维修设计的。不过，如果您要求 HP 为您更换这些部件，则根据为您的产品指定的保修服务类型，HP 可能收取或不再收取任何附加费用。

注：某些 HP 部件的设计并未考虑客户自行维修。为了满足客户保修的需要，HP 要求授权服务提供商更换相关部件。这些部件在部件图解目录中标记为“否”。

CSR 部件将在下一个工作日发运（取决于备货情况和允许的地理范围）。在允许的地理范围内，可在当天或四小时内发运，但要收取额外费用。如果需要帮助，您可以致电 HP 技术支持中心，将会有技术人员通过电话为您提供帮助。HP 会在随更换的 CSR 部件发运的材料中指明是否必须将有缺陷的部件返还给 HP。如果要求您将有缺陷的部件返还给 HP，那么您必须在规定期限内（通常是五 (5) 个工作日）将缺陷部件发给 HP。有缺陷的部件必须随所提供的发运材料中的相关文件一起返还。如果未能送还有缺陷的部件，HP 可能会要求您支付更换费用。客户自行维修时，HP 将承担所有相关运输和部件返回费用，并指定快递商/承运商。

有关 HP 客户自行维修计划的详细信息，请与您当地的服务提供商联系。有关北美地区的计划，请访问 HP 网站 (http://www.hp.com/go/selfrepair)。

客戶自行維修

HP 產品設計了許多「客戶自行維修」(CSR) 的零件以減少維修時間，並且使得更換瑕疵零件時能有更大的彈性。如果在診斷期間 HP（或 HP 服務供應商或維修夥伴）辨認出此項維修工作可以藉由使用 CSR 零件來完成，則 HP 將直接寄送該零件給您作更換。CSR 零件分為兩種類別：

- **強制的** — 客戶自行維修所使用的零件是強制性的。如果您要求 HP 更換這些零件，HP 將會向您收取此服務所需的外出費用與勞動成本。
- **選購的** — 客戶自行維修所使用的零件是選購的。這些零件也設計用於客戶自行維修之用。不過，如果您要求 HP 為您更換，則可能需要也可能不需要負擔額外的費用，端視針對此產品指定的保固服務類型而定。

備註：某些 HP 零件沒有消費者可自行維修的設計。為符合客戶保固，HP 需要授權的服務供應商更換零件。這些零件在圖示的零件目錄中，被標示為「否」。

基於材料取得及環境允許的情況下，CSR 零件將於下一個工作日以快遞寄送。在環境的允許下當天或四小時內送達，則可能需要額外的費用。若您需要協助，可致電「HP 技術支援中心」，會有一位技術人員透過電話來協助您。不論損壞的零件是否必須退回，HP 皆會在與 CSR 替換零件一起運送的材料中註明。若要將損壞的零件退回 HP，您必須在指定的一段時間內（通常為五 (5) 個工作天），將損壞的零件寄回 HP。損壞的零件必須與寄送資料中隨附的相關技術文件一併退還。如果無法退還損壞的零件，HP 可能要向您收取替換費用。針對客戶自行維修情形，HP 將負責所有運費及零件退還費用並指定使用何家快遞/貨運公司。

如需 HP 的「客戶自行維修」方案詳細資訊，請連絡您當地的服務供應商。至於北美方案，請參閱 HP 網站 (http://www.hp.com/go/selfrepair)。

고객 셀프 수리

HP 제품은 수리 시간을 최소화하고 결함이 있는 부품 교체 시 더욱 융통성을 발휘할 수 있도록 하기 위해 고객 셀프 수리(CSR) 부품을 다량 사용하여 설계되었습니다. 진단 기간 동안 HP(또는 HP 서비스 공급업체 또는 서비스 협력업체)에서 CSR 부품을 사용하여 수리가 가능하다고 판단되면 HP는 해당 부품을 바로 사용자에게 보내어 사용자가 교체할 수 있도록 합니다. CSR 부품에는 두 가지 종류가 있습니다.

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CSR 부품은 재고 상태와 지리적 조건이 허용하는 경우 다음 영업일 납품이 가능하도록 배송이 이루어집니다. 지리적 조건이 허용하는 경우 추가 비용이 청구되는 조건으로 당일 또는 4시간 배송이 가능할 수도 있습니다. 도움이 필요하시면 HP 기술 지원 센터로 전화하십시오. 전문 기술자가 전화로 도움을 줄 것입니다. HP는 결함이 발생한 부품을 HP로 반환해야 하는지 여부를 CSR 교체 부품과 함께 배송된 자료에 지정합니다. 결함이 발생한 부품을 HP로 반환해야 하는 경우에는 지정된 기간 내(통상 영업일 기준 5일)에 HP로 반환해야 합니다. 이 때 결함이 발생한 부품은 제공된 포장 재료에 넣어 관련 설명서와 함께 반환해야 합니다. 결함이 발생한 부품을 반환하지 않는 경우 HP가 교체 부품에 대해 비용을 청구할 수 있습니다. 고객 셀프 수리의 경우, HP는 모든 운송 및 부품 반환 비용을 부담하며 이용할 운송업체 및 택배 서비스를 결정합니다.

HP 고객 셀프 수리 프로그램에 대한 자세한 내용은 가까운 서비스 제공업체에 문의하십시오. 북미 지역의 프로그램에 대해서는 HP 웹 사이트(http://www.hp.com/go/selfrepair)를 참조하십시오.

Regulatory compliance notices

Regulatory compliance identification numbers

For the purpose of regulatory compliance certifications and identification, this product has been assigned a unique regulatory model number. The regulatory model number can be found on the product nameplate label, along with all required approval markings and information. When requesting compliance information for this product, always refer to this regulatory model number. The regulatory model number is not the marketing name or model number of the product.

European Union regulatory notice

Products bearing the CE marking comply with the following EU Directives:

- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC
- Ecodesign Directive 2009/125/EC, where applicable

CE compliance of this product is valid if powered with the correct CE-marked AC adapter provided by HP.

Compliance with these directives implies conformity to applicable harmonized European standards (European Norms) that are listed in the EU Declaration of Conformity issued by HP for this product or product family and available (in English only) either within the product documentation or at the following HP website (http://www.hp.eu/certificates) (type the product number in the search field).

The compliance is indicated by one of the following conformity markings placed on the product:

For non-telecommunications products and for EU harmonized telecommunications products, such as Bluetooth® within power class below 10mW.

For EU non-harmonized telecommunications products (If applicable, a 4-digit notified body number is inserted between CE and !).

Please refer to the regulatory label provided on the product.

The point of contact for regulatory matters is Hewlett-Packard GmbH, Dept./MS: HQ-TRE, Herrenberger Strasse 140, 71034 Boeblingen, GERMANY.

Disposal of waste equipment by users in private households in the European Union

This symbol on the product or on its packaging indicates that this product must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, your household waste disposal service or the shop where you purchased the product.

Korean class A notice

A급 기기 (업무용 방송통신기기)	이 기기는 업무용(A급)으로 전자파적합등록을 한 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정 외의 지역에서 사용하는 것을 목적으로 합니다.

Acronyms and abbreviations

CIM

common information model

COS

console operating system

DA

direct attached

DVFS

dynamic voltage and frequency scaling

IOPS

input/output operations per second

LFM

linear feet per minute

NAND

Not AND

PCIe

peripheral component interconnect express

SSH

Secure Shell

TSM

technical support mode

vCLI

vSphere Command Line Interface

VIB

vSphere Installation Bundle

VM

Virtual Machine

VMDK

virtual machine disk format

VMFS

virtual machine file system

VSL

virtual storage layer

VUM

VMware Update Manager

WBEM

Web-Based Enterprise Management

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